*TOP3–00200*

# Three-Dimensional Analysis Codes for Turbomachinery

## Technology

Three-dimensional (3–D) analysis codes for fans, compressors, turbines, and pumps.

## Benefits

- Higher efficiencies
- Faster design cycle times
- Lower direct operating costs
- Improved reliability

## Commercial Applications

- Axial compressors and turbines
- Centrifugal impellers
- Radial turbines
- Pumps

## Technology Description

Three-dimensional computational fluid dynamics codes have been developed at NASA Glenn Research Center for the analysis of flows in turbomachinery. The codes have been validated and have been heavily used at NASA Glenn and in U.S. industries and universities for a wide variety of problems including analysis of the space shuttle main engine turbopumps, the design of transonic fan blades, and the analysis of pumps. The codes are fairly easy to use, fast, and reasonably accurate.
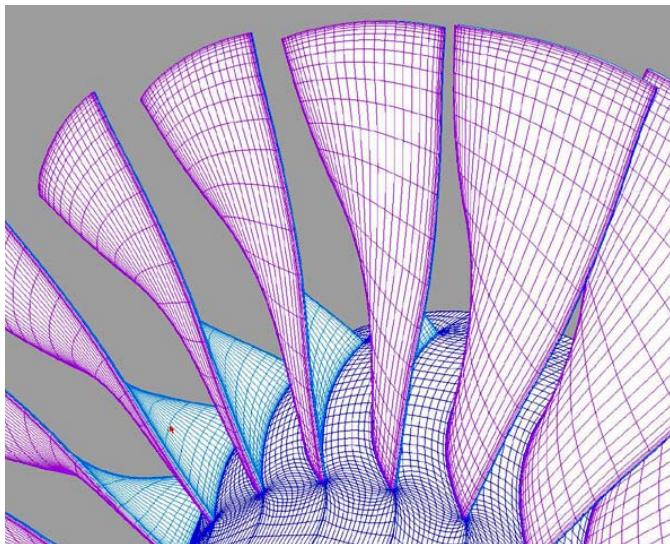


*Computational grid for a transonic fan.*
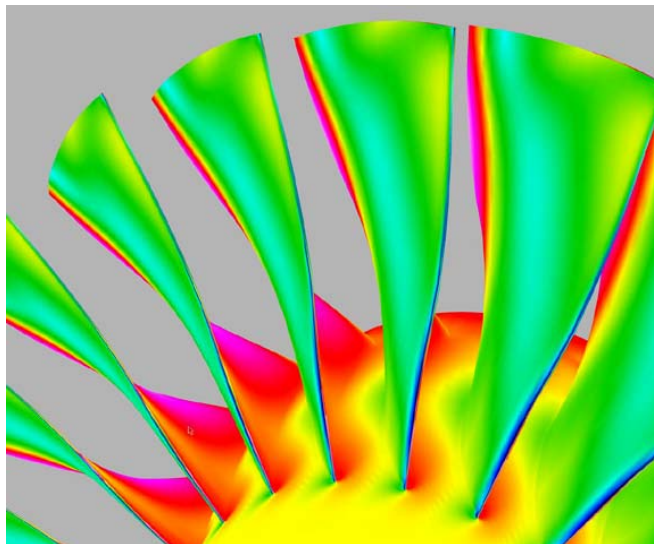


*Computed pressure contours on a transonic fan.*

Three-Dimensional Turbomachinery Analysis Codes

(a) Code descriptions

| Code | Brief code description |
|---|---|
| TCGRID | 3–D grid generation code used with swift |
| Swift | 3–D multi-block viscous analysis code |

(b) Code descriptions

| Detailed design and problem solving stage | Code requirements | Typical trade studies | Aerothermodyamic uses |
|---|---|---|---|
| TCGRID<br><br>Swift | Excellent accuracy; Fast affordable; User friendly; Robust | Grid generation; Detailed blading; Investigation of critical problem areas | Performance prediction; Pressure/thermal loads |

(c) Experience and time requirements

| Code | Typical user experience | Typical time to learn | Set-up time | Typical times for an average case | Computer required | Where to obtain the code |
|---|---|---|---|---|---|---|
| TCGRID | High | ~2 wks | < 1 day | ~ minutes | PC, UNIX | GRC SR |
| Swift | High | ~2 wks | < 1 day | ~ hours | PC, UNIX | GRC SR |

## Options for Commercialization

The codes may be used to develop and enhance design tools for commercial application and can be acquired from our NASA Glenn Research Center Software Repository (SR) at https://www. technology.grc.nasa.gov/software.

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## References

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## Key Words

Fans
Compressors
Turbines
Pumps
3–D analysis tools
Computational fluid dynamics
Grid generation

## National Aeronautics and Space Administration